Sess306, Abs 2350

Dune-slope Activity due to Frost and Wind, Throughout the North Polar Erg, Mars

Planetary Cryospheres and Polar Processes

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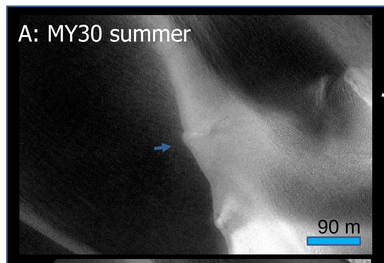
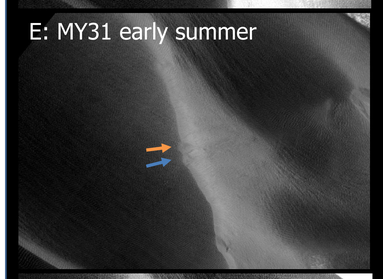
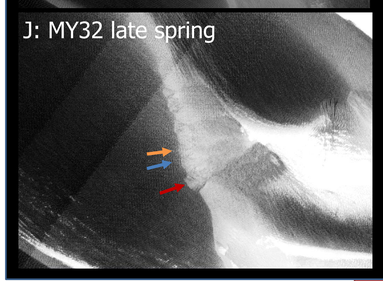
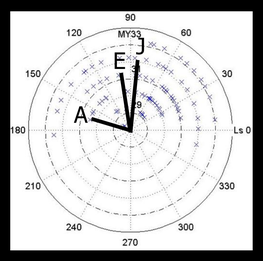






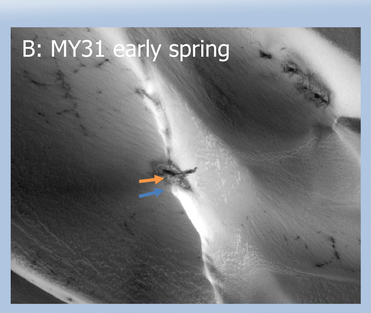
Sand flows; alcove forms.
Is frost involved, or just winds?
Hard to say, it's dark.

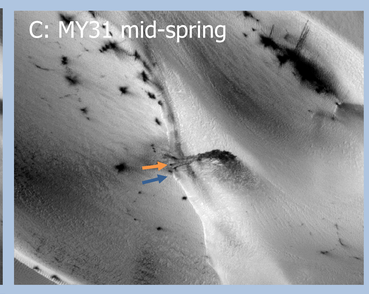


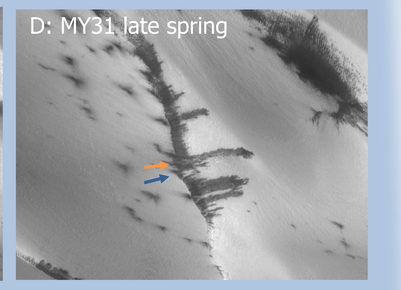
The "dial" indicates when the HiRISE image was taken – radius shows Mars year & angle shows solar longitude (L_s). Example shown was taken from the **Tleilax** study site, Mars Year (MY) 28-32 Colored arrows indicate specific alcove locations.

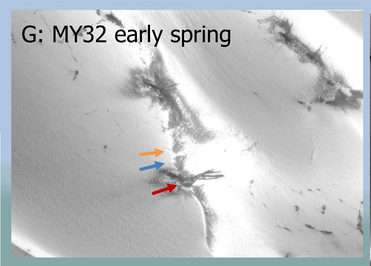
Hansen et al. (2011) noted that sublimation activity appeared enhanced within new alcoves (identified in the subsequent summer/defrosted images) and thus proposed a connection (as has been proposed for southern dune-gullies (e.g., *Diniega et al., 2010; Dundas et al., 2012; 2015*).

While it appears that alcoves and aprons do grow during the spring, initial alcove formation occurs early enough for a layer of frost to be deposited over the feature.



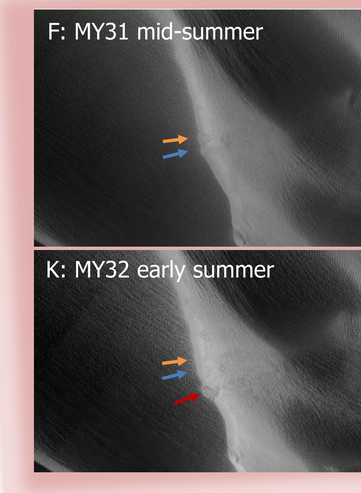




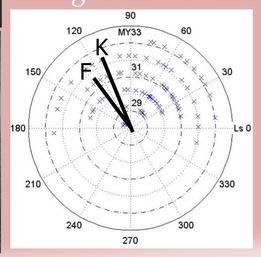


Spring-time is sublime,
As defrosting moves sand, but
Alcove was there first.

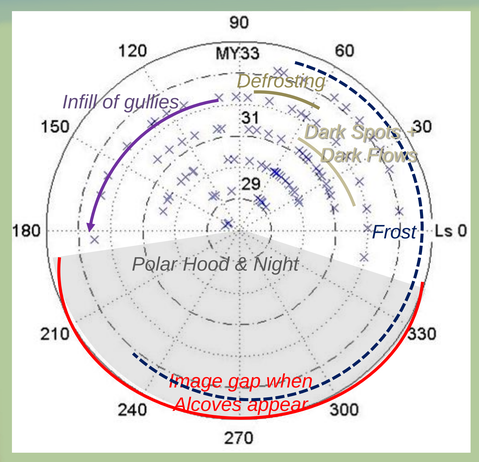
Next to, not over –
New alcoves form each frosting,
Changing the brink shape.



Horgan and Bell (2012) noted that alcoves first appeared under the frost, implying formation before the seasonal frost layer formed. Thus, they proposed that summer winds caused alcoves to form. However, we see no alcove formation during the summer. We do see in-filling of alcoves and ripple migration.



During the summer,
Alcoves fill-in,
fade away …
But no new ones form.



Hansen et al. (2015) confirmed the appearance of alcoves under the frost within a couple of fields, but constrained activity to fall/winter. Our study greatly expanded the fields and Mars years examined, and constrains the formation mechanism.

We hypothesize that the alcove formation occurs during the autumn-early winter period and is initiated, in some way, by early frost processes.

Further constraints: alcoves form regularly over all areas of the steep (downwind) slopes. Also, alcove mass-wasting is active only through one Mars year's seasonal cycle (i.e., they do not re-activate).

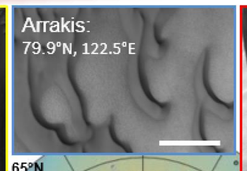
After much data:
We think autumn frost moves sand,
Summer winds erase.

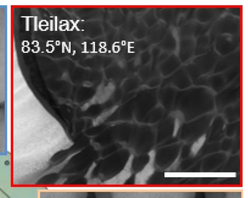
Via the rate of alcove erasure (a proxy for wind-driven sand transport), we estimate an "effective" aeolian sand fluxes of 1-few m^3/Mars year (similar to *Bridges et al., 2013*).

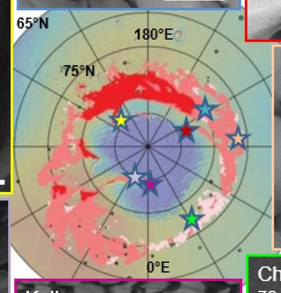
Comparing this to the rate of alcove formation, we find that alcove-formation-driven transport of sand makes up about 1/5-1/50th of the total sand flux.

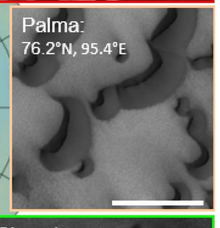
Thus: both aeolian sand transport and alcove formation processes are significantly modifying the dunes within the martian north polar erg, and both wind-driven and seasonal-frost driven processes should be considered (together) within future interpretations of polar dune morphology and evolution

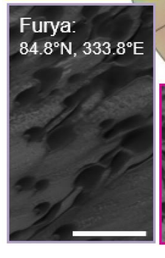
So what moves the dunes?
Need to consider alcoves
with standard dune winds.

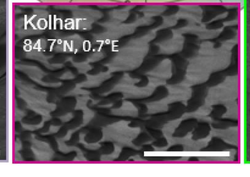


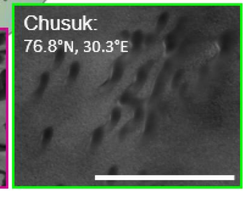


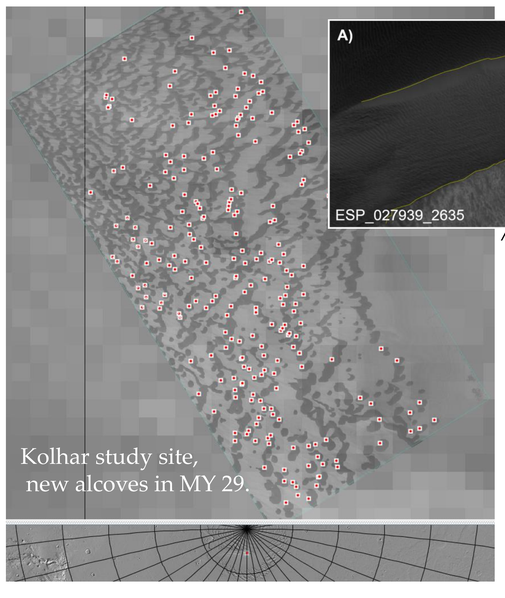


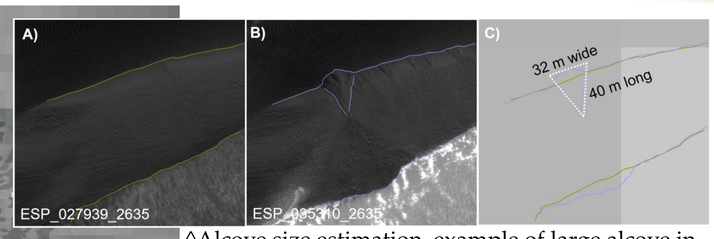












^Alcove size estimation, example of large alcove in Tleilax.

Methodology: In our study, we identified and measured new alcoves within seven study sites (at a range of lat/long) within the north polar erg, each over 1-4 Mars years. We aimed to determine alcove formation model constraints from a survey of activity and the contextual environmental conditions.

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